DOCUMENT RESUME

ED 046 219 EM 008 637

AUTHOR	Markesjo, Gunnar; Graham, Peter
TITLE	Design Techniques for Integrated Feedback.
INSTITUTION	Royal Inst. of Technology, Stockholm (Sweden).
SPONS AGENCY	Swedish Board of Technical Development, Stockholm.
REPORT NO	PE-6
PUB DATE	Jan 70
NOTE	15p.
EDRS PRICE	EDRS Price MF-$0.65 HC-$3.29
DESCRIPTORS	Audiovisual Aids, Computer Oriented Programs, Diagnostic Tests, Educational Radio, Electronics, Feedback, Higher Education, Instructional Materials, Instructional Media, Interagency Cooperation, Slides, Tape Recordings, *Teaching Models
IDENTIFIERS	CMI, Computer Managed Instruction, Stockholm, *Sweden

ABSTRACT

A model for courses in which media are used has been designed by a research group at the Royel Institute of Technology in Stockholm. The model suggests that instruction be planned for in weekly packages. These should include a limited number of instructional aids, should begin with a motivating section, and should offer training in the solving of problems. A certain amount of skill training should be included in every weekly package, and feedback in the form of diagnostic tests should be frequent. This model is now being used in a new course on electronics, prepared with the cooperation of a number of Swedish agencies. Instructional media used in this course include tape recordings, radio, slides, a students' workbook, laboratory experiment sets, a teachers' guide, and a textbook. The diagnostic tests are manually checked by the teacher during the class period on prepunched reply cards; then these cards are sent for computer checking and statistical analysis. The results of the diagnostic test can thus have a direct influence on the instruction in the classroom. The course has proved to be a strongly motivating factor for the subject of electronics--this applies to its effect on the teachers as well as on the students. It is thought to be a step in the development of computer-managed instruction (CMI). (MF)

EDO 462219

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION
THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY

Pedagogisk Elektronik

This document was processed for the ERIC Document Reproduction Service by the ERIC Clearinghouse at Stanford. We are aware that some pages probably will not be readable in microfiche or in a hardcopy enlargement. However, this is the best available copy, and we feel that the document should not be withheld from interested readers on the basis of these unreadable pages alone.

EM 008 637

REPORT PE-6

DESIGN TECHNIQUES FOR INTEGRATED FEEDBACK

Department of Education, KTH

JANUARY 1970
Gunnar Markesjö
Peter Graham

PE-gruppen KTH

Research Group on Educational Electronics
Department of Education
Royal Institute of Technology
S-100 44 STOCKHOLM 70

Report No. PE-6

DESIGN TECHNIQUES FOR INTEGRATED FEEDBACK

January, 1970

Gunnar Markesjö
Peter Graham

This project has been supported by the Swedish Board of Technical Development and The Committee for University Training Methods and has been carried out in cooperation with The Stockholm School of Education.

ED 046219

Contents

	page
DESIGN TECHNIQUES FOR INTEGRATED FEEDBACK	2
Background	2
Objectives	2
MODEL FOR DESIGN WITH INTEGRATED FEEDBACK	4
1. The uniform build-up of the weekly packages	4
2. Motivation	4
3. Solving of problems	5
4. Training in skills	5
5. Feedback	6
CASE STUDY	7
Course in applied electronics	7
1. Extent and level	7
2. Packaging of the course	7
3. Choice of media for the motivating parts	8
4. Diagnostic tests	8
5. Text material	11
6. Theory - solving of problems - application	11
Results and follow-up	12
CMI - Computer Managed Instruction	13

DESIGN TECHNIQUES FOR INTEGRATED FEEDBACK

Background

A course on Applied Electronics was planned, produced and used at the Royal Institute of Technology in Stockholm in 1968. Integrated feedback in the form of diagnostic tests of the multiple-choice type was used in this course. The answers were registered instantaneously with the aid of the electronic responder system ESAU (fig. 1 and 2). A diagnostic test was made every week and the result had a direct influence on the instruction that followed.

The course was at the same time an experiment in which the use of pre-produced TV programmes as elements of motivation was tested. The project was financed by TRU (Committee for Radio and Television in Education). The TV course was given for about 400 students and showed good results as regards both learning and attitudes.

The course has been evaluated in collaboration with the Stockholm School of Education (professors Torsten Husén and Bengt Olov Ljung) and as a result we have, among other things, developed a model for media courses with integrated feedback. The basic ideas behind the model will be discussed under the heading "Model for Design with Integrated Feedback" and we shall then present under the heading "Case Study" how this model is being used for a new course on Electronics that has been produced in cooperation with, among others, the Swedish Broadcasting Corporation, Läromedelsförlagen (publishers of educational material), the Stockholm School of Education and the PE Group at the Royal Institute of Technology in Stockholm.

Objectives

It is not practically feasible to establish strictly detailed objective specifications for a large number of college-level courses. A too detailed specification on an applied subject prevents the teachers from taking maximum advantage of their own specialities and of the resources locally available.

Sections of general objectives adjusted for the students´ self-tuition and comprising one week´s studies have proved to function well for this type of instruction.

Several of the objectives can not be specified explicitly in terms of behaviour. In such cases the design must be made so that these objectives are automatically covered during the course.

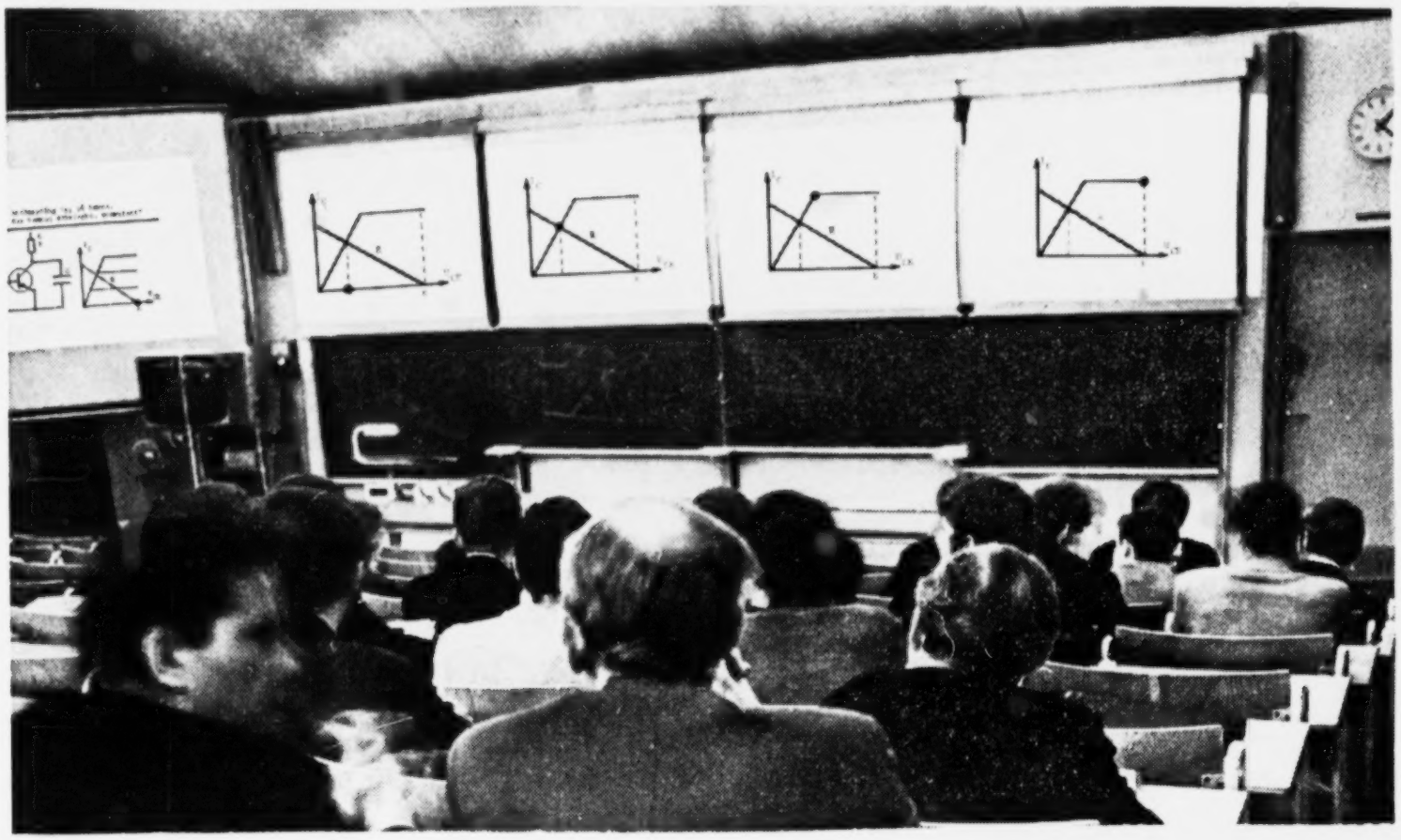

Fig. 1 Five-picture projection for the presentation of programmed diagnostic tests. A tape-recorder is used for guiding the projectors.

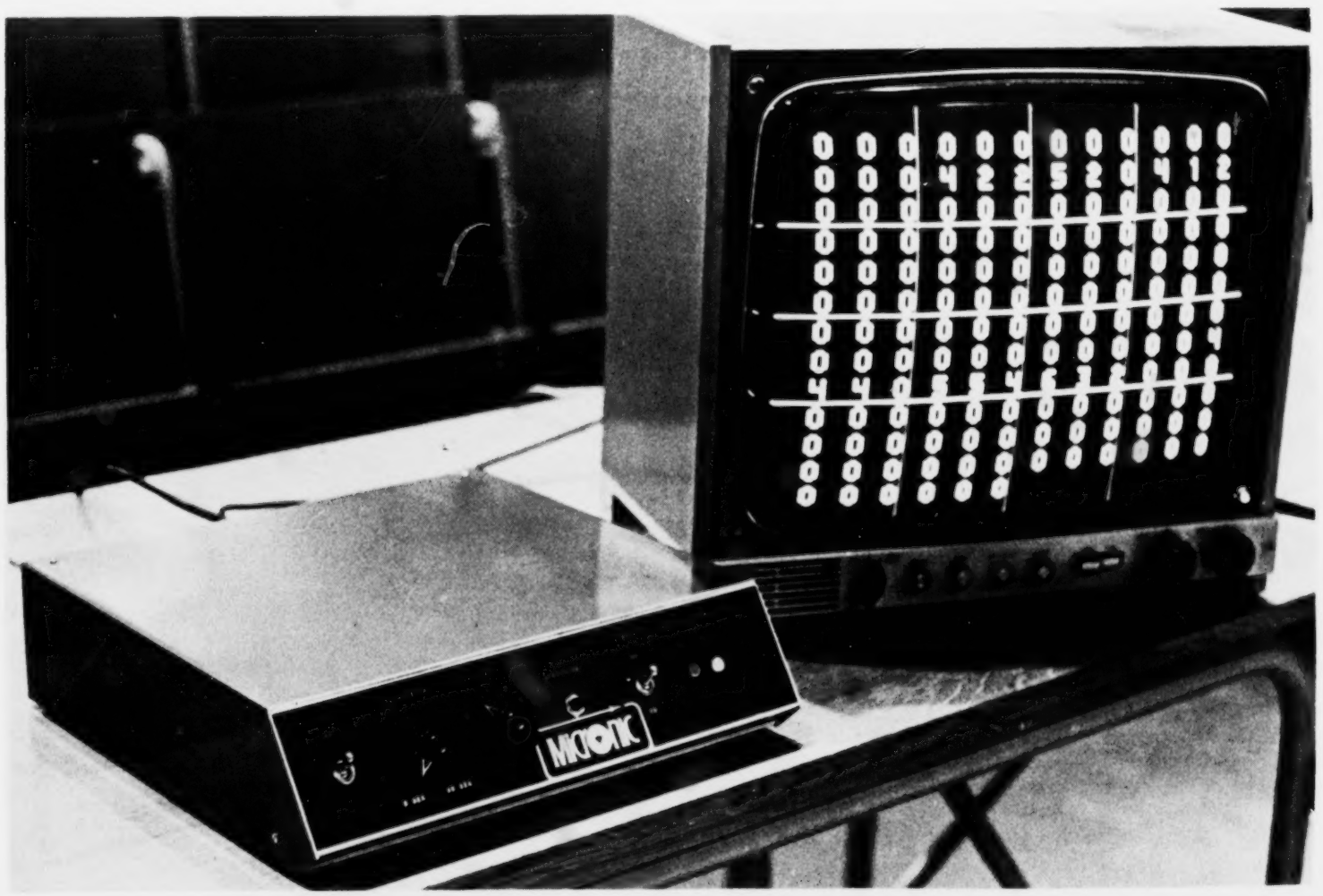

Fig. 2 ESAU. Electronic responder system for instantaneous registration of diagnostic tests.

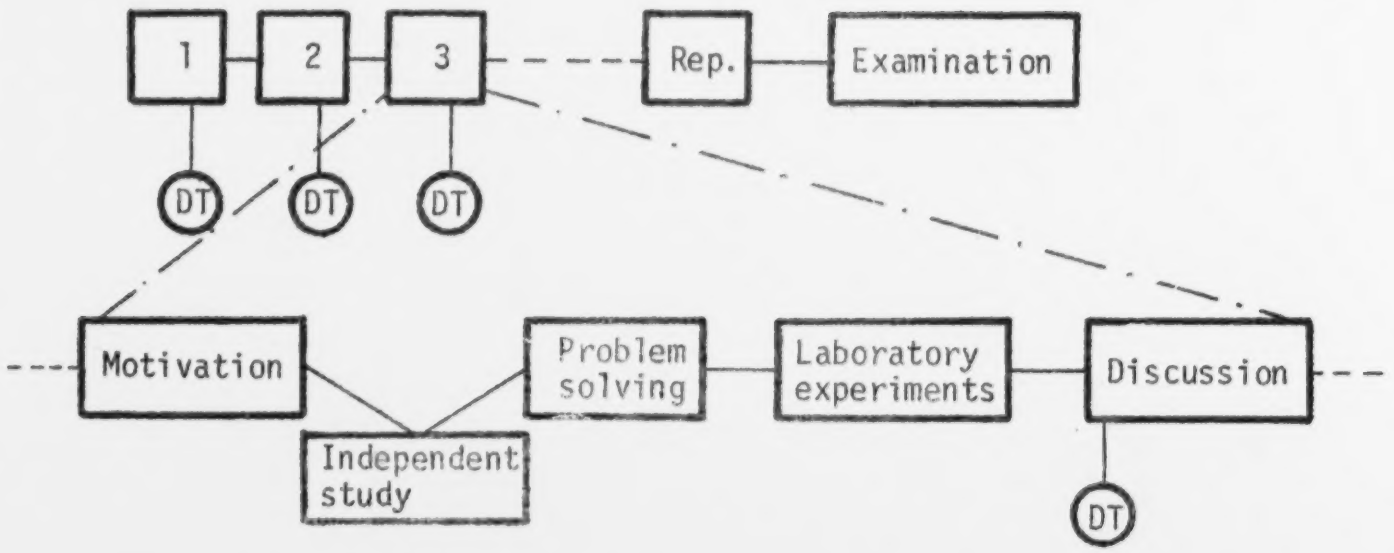

Fig. 3 A model for the packaging of a course and the positioning of the testing points (DT) for the feedback.

MODEL FOR DESIGN WITH INTEGRATED FEEDBACK

Figure 3 shows a model for the design of a weekly package in a media course. It is advatageous to use weekly packages which have a uniform build-up regarding the use of various media and activities.

1. The Uniform Build-up of the Weekly Packages

It would be easy to try and optimize every weekly package individually as regards choice of media and activities. This, however, has proved to be extremely demanding on the teachers in their preparatory work and, therefore, would not be feasible in the case of courses that are intended for a large number of classes.

Better results and a more balanced working pace can be achieved if both teachers and students get accustomed to using effectively a limited number of aids. The administrative work for the course would also become lighter.

The choice of the media and activities to be used will be a question mainly of finances and the equipment available in the participating schools.

2. Motivation

The weekly package should begin with a motivating section. This should both increase the interest in the subject and give motivation for the self-tuition (independent study) in the weekly package.

3. Solving of Problems

It is an important task for all courses in applied subjects to offer training in the solving of problems. As a result of training in the solving of problems in the exercises that precede the practical training (laboratory experiments), the solving of problems becomes realistic and thus one can avoid the "academic questions" which would otherwise come up so easily.

Fig. 4 Laboratory experiments of the "nail-lab" type.

4. Training in skills

The model is made so that a certain amount of skill training is included in every weekly package (fig. 4).

The laboratory experiments of the "nail-lab" type gives both training in skills and verification of the results of the preceding excercises in problem solving.

5. Feedback

Feedback in the form of diagnostic tests should be frequent enough to provide opportunities to adjust the instruction on the basis of the test results. Diagnostic tests can furthermore have a teaching function.

The difficulty with frequent diagnostic tests is the administrative work required and it is therefore necessary to apply rational methods to the tabulation and analysis of the test results.

Computer checking in conjunction with electronic responders for instantaneous follow-up is an attractive alternative, suitable for the CMI methods which have started to be used more and more.

The diagnostic tests have three important functions (fig. 5):

a. To inform the student of the effectiveness of his studies and about what he should repeat.

b. To inform the teacher which parts need more emphasis and time spent on them during the lessons and exercises.

c. To offer the producer of the course the necessary information for the revision of the course.

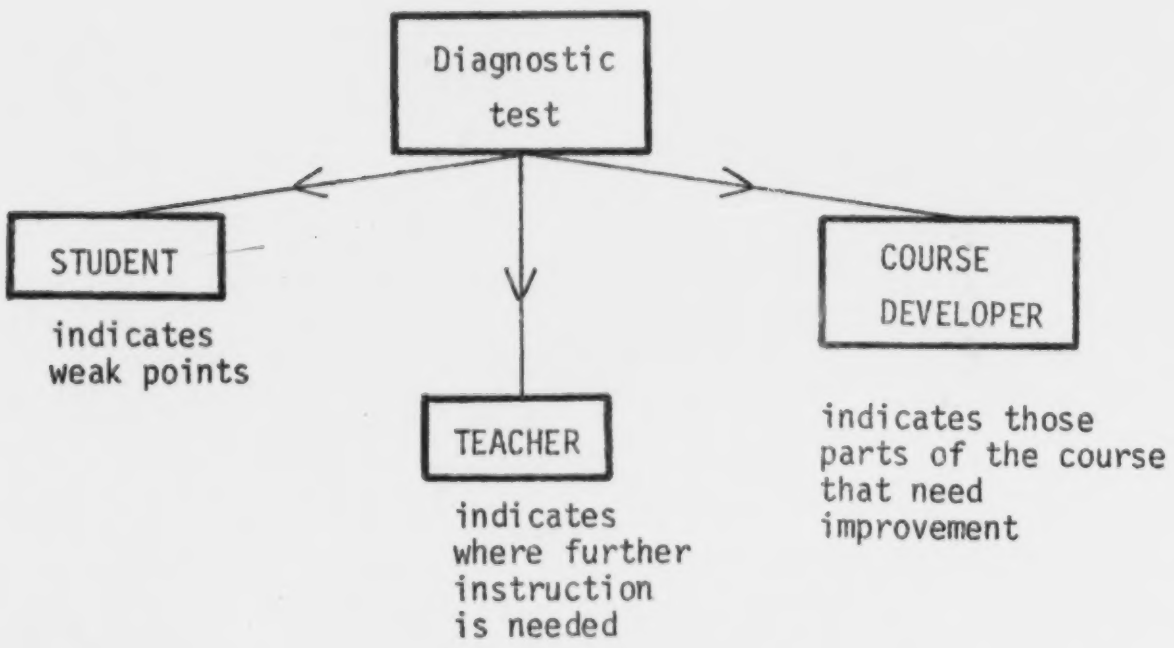

Fig. 5 The diagnostic tests give three types of feedback.

9

CASE STUDY

Course in Applied Electronics

In order to meet the big demand for new material for instruction in electronics at gymnasium level, a complete media course was prepared in Spring, 1969.

The course was produced by the PE Group at the Royal Institute of Technology in Stockholm and in collaboration with a number of organizations.

The Swedish Broadcasting Corporation was responsible for radio programmes, colour slides, students´ booklet (Work-book) and teachers´ guide.

The KLP Group at the National Swedish Office for Administrative Rationalization and Economy was responsible for the computer checking.

Terco AB produced the material for the laboratory experiment sets.

Läromedelsförlagen produced the text-book.

The Stockholm School of Education collaborated in the drafting of the tests.

1. Extent and Level

The electronic course in question comprises, according to the plan of studies, approximately 240 hours. The course is intended for the fourth form of gymnasium, i.e. the same level as for the first year at university. This course was to be followed during the school year 1969/70 by approximately 50 classes (i.e. about 1.000 students) all over the country - though not all of them were synchronized with the recommended time schedule.

2. Packaging of the Course

The course was divided into three parts, having 7, 7 and 5 weekly packages respectively. Every weekly package contains 12 hours according to the plan of studies (fig. 6 - 7).

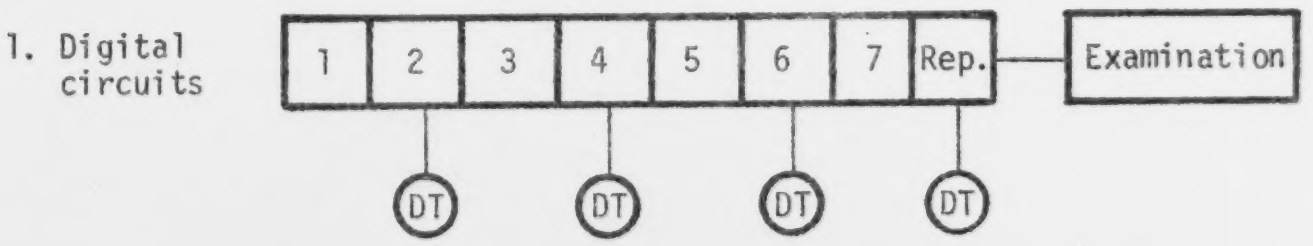

Fig. 6 The section of the course "Digital Circuits" is divided into seven weekly packages plus one week of refresher work.

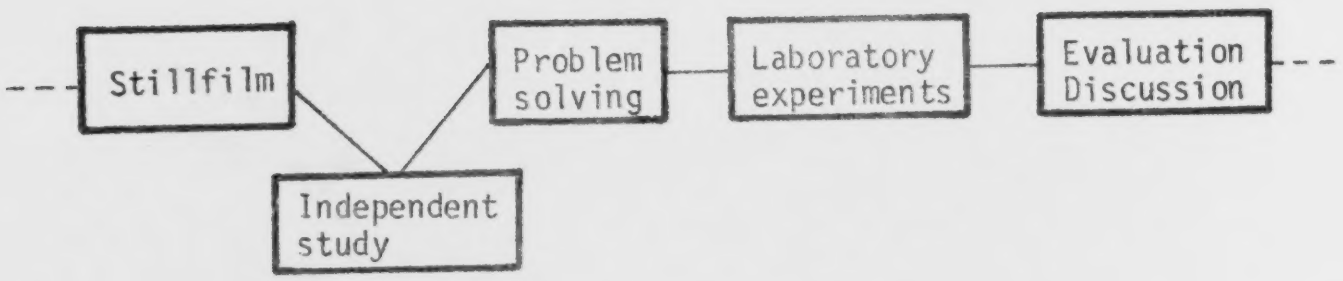

Fig. 7 Breakdown of the weekly package into various activities.

3. Choice of Media for the Motivation Parts

Because of the costs involved, neither films nor TV could be used for the motivation-creating introductory programmes for every weekly package. We, therefore, chose colour slides with taped comments. In some cases movement could have offered more to the introduction programmes but, on the other hand, colour slides offer vast possibilities both for doccumentary reporting as well as for pictures illustrating principles. Another advantage with a series of slides is that individual slides can be replaced when revising the course. The course comprises 19 radio programmes, with an average of 15 slides per programme. The commentary is distributed by the Swedish Broadcasting Corporation to the audiovisual centres of the schools through its school broadcasting. The pictures are mailed to the participating schools (in three instalments).

4. Diagnostic Tests

For the checking and the statistical analysis of the diagnostic tests the KLP Group's service [x] with optically read and prepunched reply cards was used (fig. 8).

As a result of the manual checking by the teacher of the reply cards with the aid of correct answer patterns (templates) before these cards are sent for computer checking, both the teacher and the students get an immediate feedback. The result of the diagnostic test can thus have a direct influence on the instruction in the classroom.

The tests are programmed in such a way that the questions are shown on slides and at the same time are read out in a more detailed form through the programmed tape (fig. 9). The students answer the questions by marking the correct alternative on the reply cards.

---

x) Service Group for Optical Scanning

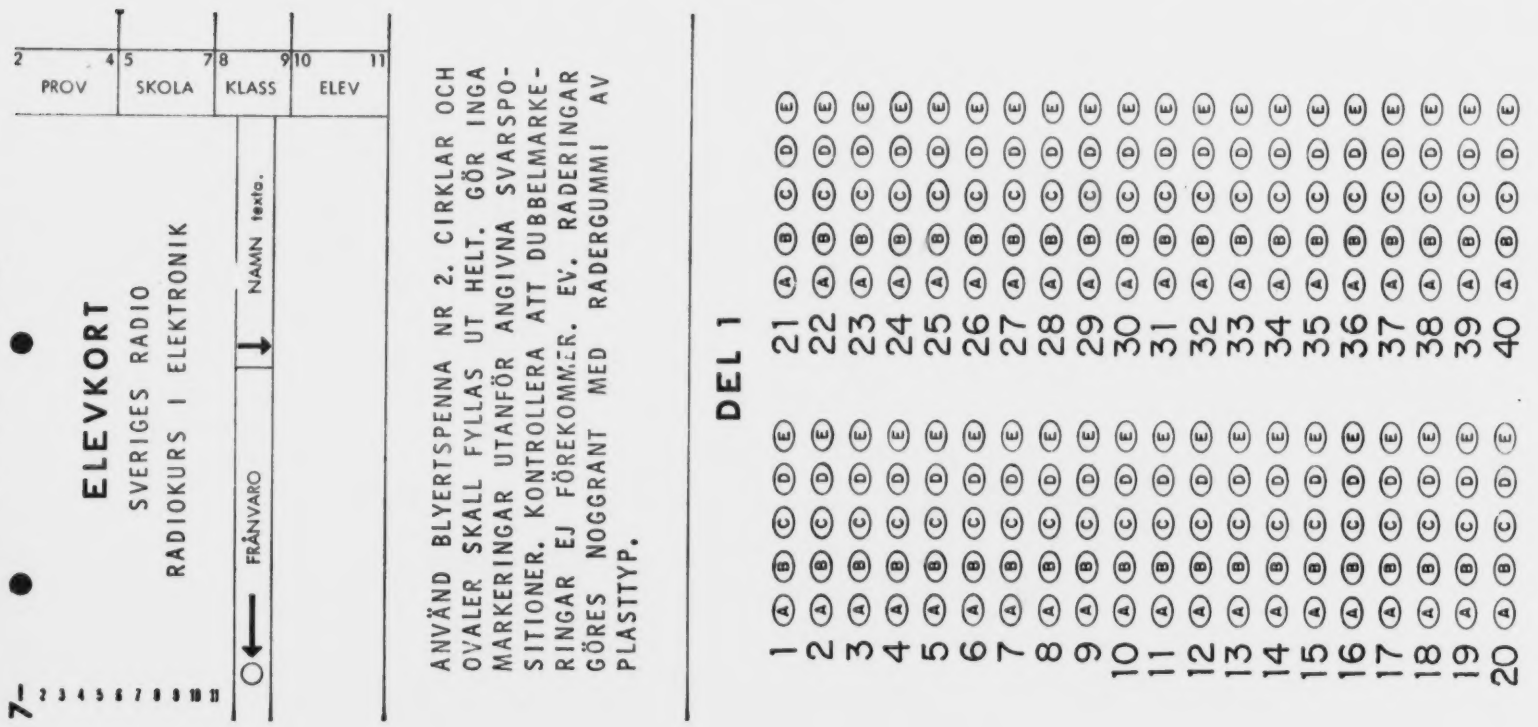

Fig. 8 Reply card for optical reading and data processing (the optical reader can process approximately 1.000 cards per minute).

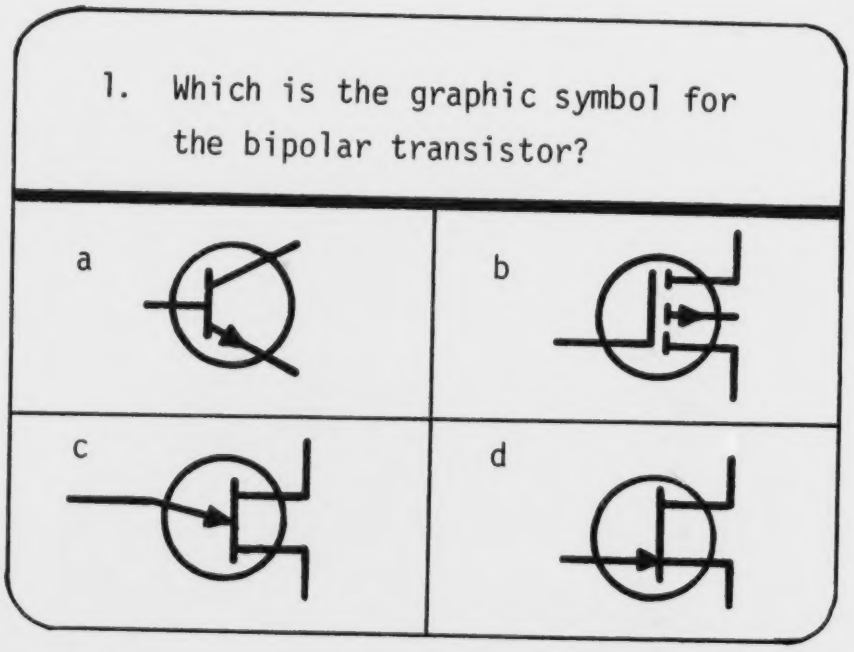

Fig. 9 A typical question from a diagnostic test, presented in slide and tape.

The teacher's manual checking takes place during a ten-minute break after the test and then a new tape, with comments on the answers, is played while the slides with the questions are shown once again.

During this stage the teacher can stop at the questions that require more information and the students have the opportunity to ask questions related to the posing of the problems. Going through a diagnostic test of this type usually results in very lively discussions between teachers and students.

After a week the class receives a summary of the results from the computer (fig. 10). This summary lists individual results, class results and average results for the entire country on the questions asked.

Fig. 10 List of results for a class. This list gives the average results for the entire country as well as the individual results for the test.

(1) Test item number. The format can handle 48 items but in this test only 12 items are used.

(2) Results from the entire country

(3) Results from the class (teacher Alf Thomasson, Växjö)

(4) Individual results. Instead of names the numbers of the pupils have been listed.

(5) Mean result in correct answers and in percentage.

5. Text Material

For financial and practical reasons it is necessary to divide the text material in such a way that at least a part of it can be revised within a short time.

The text material is therefore divided into three different categories:

A text-book that gives the necessary theoretical background. It has one chapter for each weekly section and at the end of every chapter there are both revision questions as well as references for further reading. One weekly section covers approximately 20 pages of the text-book.

A work-book with calcutation exercises and detailed instructions for the laboratory experiments of the week.

Each weekly section of the work-book starts with a section of objectives covering 4-8 points which is also the basis for the diagnostic tests.

The work-book is published in annual editions and can thus be revised swiftly. The text-book is published every two or three years and therefore any necessary corrections at shorter intervals are included in the work-book.

A teachers´ guide that contains methodical instructions on the use of the course material as well as solutions for some of the calculating exercises, hints about the difficulties of the laboratory experiments, a summary of the contents of the radio programmes etc.

6. Theory - Solving of Problems - Application

The constant aim has been to maintain as close a connection as possible between theory, the solving of problems and application during the preparation of all the weekly packages. Every weekly package is, as a rule, built-up around a laboratory experiment demanding a certain amount of problem solving as preparatory work. The weekly theory section provides the background to the problem solving and thus the theory is verified directly during the practical experiments.

Results and Follow-up

Local timetable planning differences have made it impossible for a number of classes to follow the centrally recommended timetable.

Approximately 20 classes have followed the recommended schedule and attitude tests, one for the students and one for the teachers, were held in these classes. The results of these tests show that the attitude of both students and teachers towards the media course is very positive.

The students have found the diagnostic tests to be both instructive and guiding, and the teachers have often used these tests as topics for discussions.

The course has proved to be a strongly motivating factor for the subject - this applies both to the teachers as well as to the students.

The students have found the teachers´ attitude towards the course to be very positive.

One would assume that a media course containing a large amount of material intended for self-tuition would permit the students to absorb most of the essence of the material unassisted. The test questions show, however, that this is not the case. The teacher´s role in the media course is essential but his duties are different. He can devote more time to the students for adapting and administering the given material and less time for dealing with the material itself.

The teachers´ attitude towards the course material can best be illustrated with the following question, "If similar course material was placed at your disposal, on related subjects, would you also use that?", to which the reply was a convincing "yes".

Course material in the form of ready-made packages and ready for immediate use saves so much time and work for the individual teacher that he can accept it without hesitation, though it may restrict his own influence as regards the choice of material on the subject. Through diagnostic and attitude tests, both teachers and students have the opportunity to influence the course in the long run. The teacher does not find that the comprehensive teaching material available to him restricts his role as teacher. On the contrary, he finds it a valuable form of assistance which leaves him free to give each pupil more individual attention.

CMI - Computer Managed Instruction

The electronics course is a step in the development of process controlled instruction of the CMI type.

Results from diagnostic tests, exercises, attitude tests, examinations etc. are used as checking elements (or censors). Suitably data processed, these part results can be transformed into recommendations for teachers, students and producers of courses. The results can also be used by the curators and the school board (fig. 11). By having processed test results of the successive part results available during the course, one can use them for influencing directly the instruction in various ways. A quick feedback permits a "process control" of the instruction and an individual form of assistance for the students at the time when such assistance is necessary for having the intended effect.

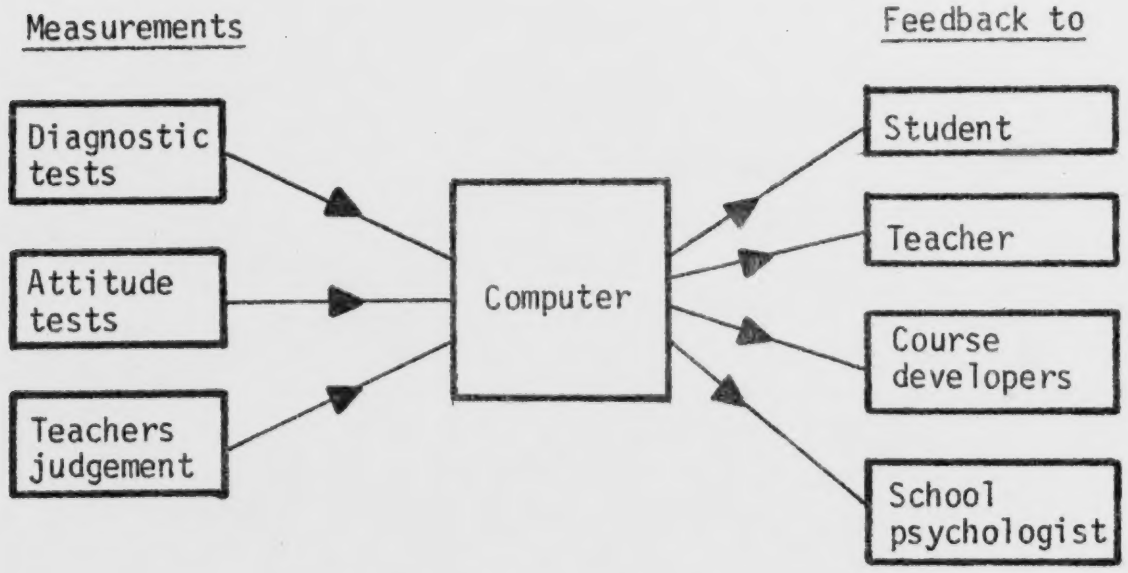

Fig. 11 CMI (Computer Managed Instruction) - model for feedback.